Training notes
6-23-2008

Class B Designer's Authority and Responsibility

1. Review rule book – 1350 GPD, shared systems, individual pipe connections, non-public systems

2. The design authority for a project may be split between an engineer and a non-engineer with one person doing either the water or wastewater system and the other person doing the other system.

3. If any portion of the water or wastewater system requires that an engineer prepare the design, the entire water or wastewater system shall be designed by an engineer.

4. A Class B Designer can design a shared water supply serving two single family residences, with each residence on its own lot, prior to completing the training and testing process. A Class B Designer may design a single pipe municipal water line connection serving a single family residence on its own lot. A Class B Designer may not design a water supply when the project involves anything other than one single family residence on a lot, even if the buildings are detached and each served by their own water supply, until completing the training and testing process.

5. When the inspection certification must be done by a designer, the designer shall be qualified to design what is being inspected. Some inspections may be performed by an installer, such as the well driller. The rules and the permit determine the requirements for inspections.

6. Expectations of quality work

Basic authority of the Water Supply Rules

1. Difference between Water Supply Rules (**WSR**) and Wastewater System and Potable Water Supply Rules **(WWR)**. Page 55 of **WWR**. Design flows for non-public water systems are set in the WW rules, page 66 **WWR**. Design flows for public water systems are set in the **WSR**, page A-11.

2. Definitions – review of WSR. Page 101 of the **WSR.**

3. Public Community Systems – residential, year round use. Includes prisons and nursing homes and other places where people live on a year round basis. Serves 15 or more connections or 25 or more people **Note:** The WSD considers 10

connections to be a public community system based on an average occupancy in Vermont of about 2.59 people per living unit (10 X 2.59 = 25 people or more)

Non-transient, non-community public systems – schools, office buildings, and other places where 25 or more of the same people use the system for at least 6 months per year

Transient, non-community systems – restaurants, shopping patrons, rest areas, and other places where 25 or more people, not routinely the same people, use the system for at least 60 days per year.

A. Churches – a special case

4. Regulated versus unregulated water supplies

The only water supplies not currently regulated are non-potable water supplies. There are new rules related to large water withdrawals for non-potable water supplies because of the public trust doctrine passed this year by the legislature.

Cross connection and plumbing code requirements also apply when there is any possibility of connecting a non-potable and a potable water supply together.

Water Supply Training for Class B Designers 11-2-2009

1. Class B Designer authority and responsibility – statute and rules
   Training notes

2. Basic authority of Water Supply Rules

   A. Difference between the Water Supply Rules and the Wastewater System and Potable Water Supply Rules page 55 of WW rules

   B. Definitions page A101

   C. Which water supplies are regulated? – exemption form

   D. Variances page 24

3. Source approval

   A. Plans and specifications page A104 **checklist**

   B. Design flow – average day demand page A105 **work sheet**

   C. Maximum day demand – minimum well yield page A105

   D. Peak demand – plumbing code fixture units concepts page A105 continuous flow fixtures versus intermittent flow fixtures, IPC 2003 **worksheet**

   E. Isolation distances – page A105

      Confined versus unconfined aquifers

      Well shield - **worksheet**

   F. Construction standards - page 111

   G. Quantity testing – page 112

      i. Pump testing

      ii. Interference testing

      iii. Long term yield calculations

   H Quality testing - page 115

5. Distribution system issues

   A. Requirements for flow and pressure at the buildings – including systems with more than one building – based on calculations of static and dynamic head and friction loss - **checklist and worksheet**

   B. General details - page A117

   C. Disinfection - page A117

   D. Storage requirements – page A121

      i. Instantaneous peak yield testing

      ii. Storage volume required - worksheet

      iii. Casing storage – **worksheet**

      iv. Construction details - Coatings – use NSF Certified Potable Water materials web site www.nsf.org

      v. Disinfection – page A126

      vi. Reasons and methods to avoid storage

   E. Distribution system design – page A127

      i. Standard construction issues – tap, corporation stop, gooseneck, curb stop, valve box, piping materials, joint systems

      ii. Trenching, bedding, roadways, source protection areas

      iii. Crossing and parallel installation issues

      iv. Pumps – sizing for flow and head **worksheet**

      v. Booster pumps – prohibition of inline booster pumps

      vi. Cross connections

6. Well construction standards for various types of wells

   A. Shallow wells - page A111

   B. Drilled wells – page A134

   C. Decisions that must be made by site technician versus the well driller –

   D. What must be certified on the plans and in the inspection by the site technician versus the well driller?

7. Well abandonment issues – page 146

8. Homework problem - handout

Water supply design checklist 7-18-2005

Note: This is an incomplete start at a checklist which might be a basis for developing <u>your</u> own more complete checklist.

1. Average day demand ______________

2. Maximum day demand _____________

3. Peak day demand ______________

4. Source capacity _________________

5. Storage capacity _______________

6. Pump capacities

   A. Well pump _______________

   B. Booster pump _____________

7. Operating pressures

   A. At highest fixture _________________

   B. At pressure tank _________________

   C. Highest pressure in the system ______________

8. Flood plain issues

   Located within the floodplain but not floodway?

   If yes:

   A. Elevation of grading around well ______________

   B. Elevation of top of casing _________________

9. Hazardous site issues ________________

10. Plans and specifications

   A. Plan view

   B. Surface drainage and general topography

   C. Neighboring wells, wastewater systems, and their piping locations

   D. Well shields

   E. Location of system components
      Piping, valving, and standard pressure

   F. specific construction standards

11. Isolation distances

   A. If the well is not cased into competent bedrock, is the well finished in the unconsolidated aquifer to which a wastewater disposal system discharges? If so, use shallow well isolation distances.

   B. Check for agricultural cropland and ROW where herbicides are used.

12. Quantity testing

   A. Well driller's estimate ___________ GPM

   B. Long yield based on pump test _______________ GPM

   C. Instantaneous yield test ______________GPM.

   D. Checked for interference

13. Quality testing

   A. Required for anything other than SFR

   B. Required for SFR when there is reason to suspect contamination

Checklist for sizing water distribution system 7-25-2005

1. Instantaneous peak demand

   A. Demand from intermittently used fixtures, WSFU converted to GPM

   \+ B. Demand from continuous flow fixtures in GPM, including sprinkler heads

2. Pressure required at fixtures to produce required flow, or to make the fixture operate properly

3. Static pressure, if municipal connection

4. Static head from source to fixtures

5. Friction loss through meter

6. Friction loss through taps in water main

7. Friction loss through filters, softeners, backflow prevention devices, and pressure regulators

8. Friction loss through valves and fittings

9. Friction loss through pipe

Use International Plumbing Code
Appendix E
Table 103.3(2), 103.3(3), 103.3(6)
Figure 103.3(2)

Worksheet for peak demand calculations 6-23-2008

1. Basic concepts

   A. A project may have more than one connection, particularly when a municipal water supply is involved. All calculations are based on the plumbing fixtures and other uses supplied through a particular pipe, not on the total for the whole project.

   B. Plumbing fixtures such as toilets and lavatories use the conversion charts to determine peak demand as these are considered to be intermittent flow fixtures. The calculation starts with fixture units and is converted to GPM.

   Hose bibbs, lawn watering systems, and similar uses are considered continuous flow fixtures and their flow is calculated based on the GPM flow of those fixtures. These flows are not listed in the plumbing code as they vary with the particular unit used. Use conservative assumptions of flow or determine the capacity of the particular unit proposed for installation.

   Peak demand is determined by adding the two numbers together.

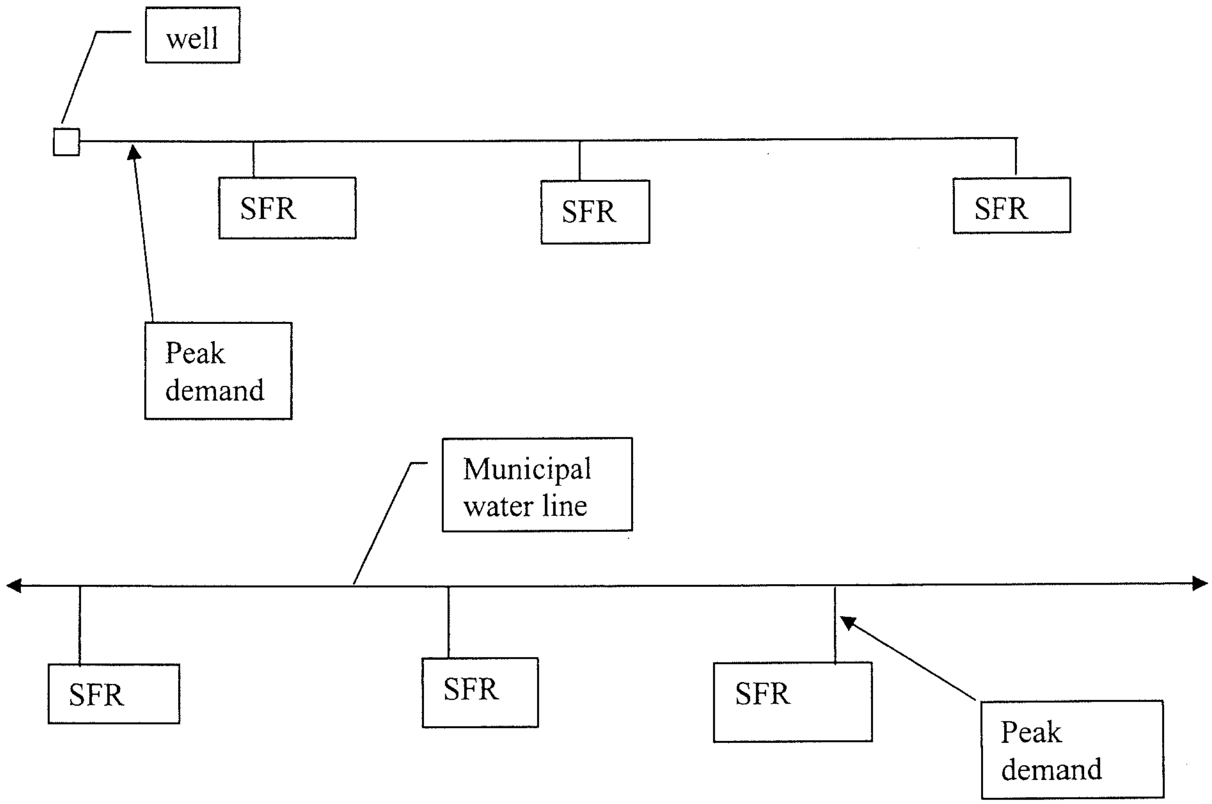
(Use fixture unit method, not an assumption of 5 GPM per unit.)

1. Three SFRs, each with two full baths, a kitchen sink, and one hose bibb for each unit. Assume that one well supplies all water.

2. One SFR with full bath and kitchen sink, plus three office spaces with ½ bath in each office space. Assume that one well supplies all water.

3. Store with ½ bath for employees and a deli operation. Deli has a three bay sink, a handwash sink, and a dishwasher. Assume that one well supplies all water.

4. Two duplex buildings, each individually connected to a municipal water system. Each living unit has one full bath, one half bath, a kitchen sink and each building has a clothes washer and dryer in the common basement space.


well
SFR
SFR
SFR
Peak demand
Municipal water line
SFR
SFR
SFR
Peak demand

Intermittent Flow Fixtures

Type of fixture	Load value per Unit	# of units	Total

Total load value for all fixtures ________________

GPM based on conversion using table ____________________

Continuous Flow Fixtures

Type of fixture	GPM per unit	# of units	Total GPM

Total GPM for continuous flow fixtures __________________

GPM (from load values) + GPM (continuous flow) = Peak Demand in GPM ___________

Checklist for sizing water distribution system 7-25-2005

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8. Friction loss through valves and fittings

9. Friction loss through pipe

Worksheet for head loss calculations – 6-19-2008

Head loss is usually expressed as feet of head, not as pounds per square inch

Residual head = static head (+/-) difference in elevation (-) friction loss

Assume 2.3' of head per 1 PSI

1. Pressure at main 75 PSI
2. Elevation at main 100'
3. Elevation at highest fixture 135'
4. 89' of 3/4" copper line
5. 2 bends of 90^0
6. 1 gate valve
7. 14 GPM instantaneous peak demand

What is the residual pressure at the highest fixture? _______________

Second worksheet for pressure loss 6-19-2008

Pressure loss and residual pressure is usually expressed as pounds per square inch

Residual pressure = static pressure (+/-) difference in elevation (-) friction loss

Assume 2.3' of head per 1 PSI

1. Elevation at entrance to building 97'
2. Static pressure at the water main 60 PSI
3. 125' of 3/4" copper line between the main and the entrance to the building
4. Elevation at the water main 95'
5. The pipe to the building includes 3 bends of 45 degrees
6. The required flow is 5 GPM

What is the residual pressure at the building entrance? ______________________

Third worksheet for pressure loss 11-2-2009

Pressure loss and residual pressure is usually expressed as pounds per square inch

Residual pressure = static pressure (+/-) difference in elevation (-) friction loss

Assume 2.3' of head per 1 PSI

1. Elevation at entrance to first building 100'
2. Static pressure at the water main 60 PSI
3. 125' of 3/4" copper line between the main and the entrance to the first building
4. Elevation at the water main 105'
5. The pipe to the first building includes 3 bends of 45 degrees
6. The required flow for the first building is 5 GPM
7. The water supply runs from the first building to a second building which has a required design flow of 5 GPM.
8. The pipe from the entrance to building #1 to the entrance to building #2 is 100' of 3/4" copper.
9. The elevation at the entrance to the second building is 90'

What is the residual pressure at each building entrance?

Water Storage System Design 9-29-2010

If the long term yield of the water source meets or exceeds the peak instantaneous demand (IPD), storage is not required as long as the source pump can meet the IPD. If the source can meet the long term yield requirement but does not meet the IPD, an abbreviated pump test may be done per section 11.8.2.2. If the source satisfies the IPD pump test, storage is not required. For all other situations, storage is required unless section 11.8.2.1 provides an exemption.

1. Section 11.8.2.1 -

   Storage is not required, even if the source cannot meet the IPD if:

   A. the water system serves only one single family residence;

   B. the water system serves only one single family residence of not more than 3 bedrooms and a one bedroom apartment. This exceeds the 540 GPD noted in the Water Supply Rules but is allowed because the building complex of a single family residence of 3 bedrooms plus a 1 bedroom apartment is approved and the design flow changed after adoption of the Water Supply Rules from 540 GPD to 560 GPD; or

   C. the water system serves only one non-residential building with a design flow of 500 GPD or less and with an instantaneous peak demand of 15 GPM or less.

Note: The long term well yield must meet the maximum daily demand even if the above exemption from storage applies. A water system design is required and the pump must meet IPD.

2. Section 11.8.2.3 –

   Storage is required if the water source cannot supply the IPD. If required, the storage is calculated as described below.

   A. a storage tank may be used when the water source capacity is insufficient to meet the instantaneous peak demand. The minimum long term well yield that can be approved for new project or a project with an increase in design flow is 2/3 of the maximum day demand. A project with a design flow of 1000 GPD, with ordinary usage characteristics, has a maximum daily demand of $1000 \div 720 = 1.38$ GPM. 67% of 1.38 GPM = 0.93 GPM and is the minimum long term well yield that will support the project. This project could be approved using a storage tank with a design capacity of 1000 gallons;

B. A smaller tank may be used when the source exceeds the maximum daily demand required for the project but still does not meet the instantaneous peak demand. If the long term well yield meets or exceeds the maximum daily demand a storage tank that holds at least 55% of the design flow is acceptable. The well pump must meet or exceed the maximum daily demand.

C. When the long term source capacity substantially exceeds the maximum daily demand but is still less than the instantaneous peak demand, a still smaller tank may be used based on the following calculation;

$S = D(1-Y/P)$

S – storage volume required (gallons)

D – average day demand (gallons) (aka design flow)(Appendix A, Subpart 11.3)

Y – water source yield (gallons per minute) (either long term yield per Appendix A, Subpart 11.6 or peak yield per Appendix A, Subpart 11.8.2.2)

P – instantaneous peak demand (gallons per minute) (Appendix A, Subpart 11.3)

Example

Average day demand is 950 gallons. The long term well yield is 8 GPM. The instantaneous peak demand is 10 GPM.

$S = 950(1- 8/10)$ or 190 gallons

Worksheet for water storage 11-9-2009

Specify the <u>minimum</u> amount of storage capacity for the following situation:

1. 2 single family homes of 3 bedrooms each with a combined instantaneous peak demand of 10 GPM with a long term well yield of 2 GPM.

Worksheet for water storage 10-27-2009

Specify the minimum amount of storage capacity for the following situation:

1. 2 single family homes of 3 bedrooms each with a combined instantaneous peak demand of 10 GPM with a well yield of 2 GPM.

   2(420 GPD) = 840 GPD

   S = 840(1- 2/10) or 672 gallons

   However, maximum day demand is 840 GPD/720 minutes or 1.16 GPM and with a well yield of 2 GPM the minimum storage is 55% of the design flow or 462 gallons of storage.

Worksheet for casing storage 12-10-2007

1. Standard 6" well casing
2. Ground elevation 1000'
3. Static water elevation 980'
4. Elevation of bottom of well 811'
5. Well pump installed 20' above bottom of well.
6. Maximum day demand is 1.9 GPM
7. Long term yield is 3.8 GPM

DD = SE + (TAH X (MDD/Y))

SE =

TAH =

MDD/Y =

What is the predicted depth to the water level in the well? DD = __________

How much casing storage exists? ____________________

Worksheet for selecting a deep well pump 7-20-2005

1. System must supply 5 GPM at pressure tank

2. Elevation of water level in well at maximum expected drawdown. 735'

3. Elevation of pressure tank 980'

4. Pump off pressure 50 PSI
   Pump on pressure 30 PSI

   Assume pressures have been selected to provide adequate flow to all fixtures.

5. Head loss in pipe from pump to pressure tank 8 PSI.

At what head must the pump supply 5 GPM? ______________

What is the maximum head the pump must supply? __________

Using the pump specifications, select an appropriate well pump. ____________

Water Storage System Design 9-29-2010

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